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04-163701
Presidio Viaduct SB
Bridge No. 34-0157L

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**Subject:** Supplemental Foundation Report

This report presents the supplemental Foundation Recommendations and is an addendum to the Final Foundation Report submitted to you dated July 13, 2009 for the proposed 6-span Presidio Viaduct South Bound (34-0157L) in the city of San Francisco. It should be noted that the previous Foundation Report dated July 13, 2009 is in your possession. However, the inclusion of a second alternative in the foundation/structure warranted changes to the foundation report. This report does not supersede the recommendations contained in the July 13, 2009 report. It simply provides a second alternative. Therefore, all the contents except for the tables included in this supplemental report are still valid and considered final.

Furthermore, the original design as outlined in the aforementioned Foundation Report will be refered to as Alternative A, whereas the option as outlined in this supplemental report will be referred to as Alternative B.

**Foundation Recommendations for Alternative B**

According to the data provided by you in the latest Foundation Design Data Sheet submitted on September 8, 2009, the alternative foundation for the proposed replacement structure consists of Cast-In-Drilled-Hole (CIDH) piles supporting pile caps at the abutments and, single large diameter CIDH pile extensions at bents 2, 3, 4, 5, and 6. The pile sizes at the bents, as well as pile cap dimensions, and bottom of pile cap elevations at the abutments were provided by your Office on August 28, 2009.

There are no changes to the Abutments. Abutment 1 still consists of a 44.5 foot by 14 foot pile cap supported by twenty-six 24-inch diameter CIDH piles. The foundation at Bents 2, 3, and 4 consist of 10-foot diameter CIDH piles with permanent steel casings, and 9.5-foot diameter CIDH rock sockets. The foundation at Bents 5 and 6 consist of single 11.5-foot and 8.5-foot CIDH piles, respectively, with column isolation from top of ground and extending to the pile cutoff elevations within the formational rock. Abutment 7 still consists of a 51 foot by 14 foot pile cap supported by twenty-three 24-inch CIDH piles. The following tables provide the foundation details.

**Table 1 - General Foundation Information Provided by Structure Designer (Alternative B)**

| Support Location | Pile Type | Original Ground Elevation (Ft) | Pile Cut-off Elevation (Ft) | Permissible Settlement Under Service Load |
|---|---|---|---|---|
| Abutment 1 | 24-inch CIDH | 81 | 71.25 | 25.4 mm (1 in) |
| Bent 2 | 120-inch CIDH with 114-inch CIDH rock rocket | 58 | 36 | 25.4 mm (1 in) |
| Bent 3R | 120-inch CIDH with 114-inch CIDH rock rocket | 40 | 37.6 | 25.4 mm (1 in) |
| Bent 3L | 120-inch CIDH with 114-inch CIDH rock rocket | 42 | 37.6 | 25.4 mm (1 in) |
| Bent 4R | 120-inch CIDH with 114-inch CIDH rock rocket | 47 | 45 | 25.4 mm (1 in) |
| Bent 4L | 120-inch CIDH with 114-inch CIDH rock rocket | 51 | 45 | 25.4 mm (1 in) |
| Bent 5 | 138-inch CIDH | 76 | 70 | 25.4 mm (1 in) |
| Bent 6 | 102-inch CIDH | 121 | 95 | 25.4 mm (1 in) |
| Abutment 7 | 24-inch CIDH | 136 | 129.5 | 25.4 mm (1 in) |

## Table 2 - Foundation Design Loads Provided by Structure Designer (Alternative B)

| Support Location | Service 1 Limit State (kips) | | | Strength Limit State (Controlling Group) (kips) | | | | Extreme Event Limit State (Controlling Group) (Kips) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Loads | | Permanent Loads | Compression | | Tension | | Compression | | Tension | |
| | Per Column | Max Per Pile | Per Support per column | Per Column | Max Per Pile | Per column | Max Per Pile | Per Column | Max Per Pile | Per Column | Max Per Pile |
| Abut 1 | 3429/supp | 165 | 2965/supp | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Bent 2 | N/A | 8350 | 7300 | N/A | 12480 | 0 | 0 | N/A | 7300 | 0 | 0 |
| Bent 3R | N/A | 5100 | 4290 | N/A | 7925 | 0 | 0 | N/A | 10839 | N/A | -2259 |
| Bent 3L | N/A | 5100 | 4290 | N/A | 7925 | 0 | 0 | N/A | 10839 | N/A | -2259 |
| Bent 4R | N/A | 7080 | 6005 | N/A | 10880 | 0 | 0 | N/A | 9959 | 0 | 0 |
| Bent 4L | N/A | 7080 | 6005 | N/A | 10880 | 0 | 0 | N/A | 9959 | 0 | 0 |
| Bent 5 | N/A | 6470 | 5440 | N/A | 10080 | 0 | 0 | N/A | 5440 | 0 | 0 |
| Bent 6 | N/A | 4240 | 3320 | N/A | 6860 | 0 | 0 | N/A | 3320 | 0 | 0 |
| Abut 7 | 2679/Supp | 174 | 2364/supp | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

*Foundation Design Recommendations for the abutments and bent locations are provided in the following three tables. Nominal Resistances are provided by a combination of side resistance and base resistance in rock. The Nominal Resistance for drilled shafts does not include any contributions from side shear in soil.*

## Table 3 - Foundation Design Recommendations for Abutments 1 and 7 (Alternative B)

| Abutment Foundations Design Recommendations | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Support Location | Pile Type | Cut-off Elevation (Ft) | LRFD Service-I Limit State Load (kips) per Support | | LRFD Service-I Limit State Total Load (kips) per Pile (Compression) | Nominal Resistance (kips) | Design Tip Elevations (Ft) | Specified Tip Elevation (Ft) |
| | | | Total | Permanent | | | | |
| Abut. 1 | 24-inch CIDH | 71.25 | 3429 | 2965 | 165 | 330 | 36 (a) | 36 |
| Abut. 7 | 24-inch CIDH | 129.5 | 2679 | 2364 | 175 | 350 | 90 (a) | 90 |

**Table 4 - Foundation Design Recommendations for Bent 2 through Bent 6 (Alternative B – 10-ft Pile Shafts at bents 2, 3, and 4)**

| Support Location | Pile Type And size | Cut-Off Elevation (Ft) | Service-I Limit State Load per Column (Kips) | Total Permissible Support Settlement | Required factored Nominal Resistance (kips) | | | | Maximum Specified Tip Elevation (Casing) (Ft) | Design Pile Tip Elevation (Ft) | Specified Pile Tip Elevation (Ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Strength Limit | | Extreme Event | | | | |
| | | | | | Comp. ($\varphi$=0.6) | Tension ($\varphi$=0.6) | Comp. ($\varphi$=1) | Tension ($\varphi$=1) | | | |
| Bent 2 | 120-inch CIDH with 114-inch CIDH rock rocket | 36 | 8350 | 1 inch | 12480 | 0 | 7300 | 0 | -9 | -70(a) | -70 |
| Bent 3R | 120-inch CIDH with 114-inch CIDH rock rocket | 37.6 | 5100 | 1 inch | 7925 | 0 | 10839 | -2259 | -121 | -164 (a)<br>-128 (b) | -164 |
| Bent 3L | 120-inch CIDH with 114-inch CIDH rock rocket | 37.6 | 5100 | 1 inch | 7925 | 0 | 10839 | -2259 | -103 | -154(a)<br>-108 b) | -154 |
| Bent 4R | 120-inch CIDH with 114-inch CIDH rock rocket | 45 | 7080 | 1 inch | 10880 | 0 | 9959 | 0 | -30 | -92(a) | -92 |
| Bent 4L | 120-inch CIDH with 114-inch CIDH rock rocket | 45 | 6460 | 1 inch | 10880 | 0 | 9959 | 0 | -21 | -82 (a) | -82 |
| Bent 5 | 138-inch CIDH | 70 | 6470 | 1 inch | 10080 | 0 | 5440 | 0 | N/A | 27 (a) | 27 |
| Bent 6 | 102-inch CIDH | 95 | 4240 | 1 inch | 6860 | 0 | 3320 | 0 | N/A | 50 (a) | 50 |

## Table 5 - Pile Data Table
## (Alternative B – 10-ft Pile Shafts at Bents 2, 3, and 4)

| Location | Pile Type And size | Nominal Resistance | | Maximum Permanent Casing Tip Elevation (Ft) | Design Tip Elevation (Ft) | Specified Tip Elevation (Ft) |
|---|---|---|---|---|---|---|
| | | Compression (Kips) | Tension (Kips) | | | |
| Abut 1 | 24-inch CIDH | 330 | N/A | N/A | 36 (a) | 36 |
| Bent 2 | 120-inch CIDH with 114-inch CIDH rock rocket | 20,800 | 0 | -9 | -70 (a) | -70 |
| Bent 3R | 120-inch CIDH with 114-inch CIDH rock rocket | 13,200 | 0 | -121 | -164 (a)<br>-128 (b) | -164 |
| Bent 3L | 120-inch CIDH with 114-inch CIDH rock rocket | 13,200 | 0 | -103 | -154 (a)<br>-115 (b) | -154 |
| Bent 4R | 120-inch CIDH with 114-inch CIDH rock rocket | 18,200 | 0 | -30 | -92 (a) | -92 |
| Bent 4L | 120-inch CIDH with 114-inch CIDH rock rocket | 18,200 | 0 | -21 | -82 (a) | -82 |
| Bent 5 | 138-inch CIDH | 16,800 | 0 | N/A | 27 (a) | 27 |
| Bent 6 | 96-inch CIDH | 11,500 | 0 | N/A | 50 (a) | 50 |
| Abut 7 | 24-inch CIDH | 350 | N/A | N/A | 90 (a) | 90 |

*Notes:*

1) *The design tip elevations at the abutments are controlled by (a) Compression.*
2) *The design tip elevation for settlement is not applicable at the abutments since the CIDH piles are required to penetrate into rock as reflected by the specified tip elevations.*
3) *CIDH specified pile tip elevations shall not be raised.*
4) *The design tip elevations for Lateral Loads are typically provided by Structure Design.*
5) *The design tip elevations for the Bents are controlled by: (a) Compression (b) Tension.*
6) *The specified tip elevation shall not be raised above the design tip elevation.*
7) *The design tip elevation for settlement is not applicable at the bents since the CIDH piles are required to penetrate into rock as reflected by the specified tip elevations.*

## General Notes:

1) All support locations are to be plotted in plan view on the Log of Test Borings as stated in "Memo to Designers" 4-2. The plotting of support locations should be made prior to requesting a final foundation review.

2) When applicable, the structure engineer shall show on the plans, in the pile data table, the design pile tip elevation required to meet the lateral load demands. If the design pile tip elevation required to meet lateral load demands exceeds the specified pile tip elevations given within this report, the Office of Geotechnical Design-West shall be contacted for further recommendations.

## Construction Considerations:

### Cores Samples

1) Core samples from the 2008 and 2009 Caltrans foundation investigations were available for viewing by bidders at the California Department of Transportation, Transportation Laboratory, 325 San Bruno Avenue, San Francisco, CA 94103. Effective September 8, 2009, the core samples will be available for viewing at California Department of Transportation, Transportation Laboratory, 5900 Folsom Boulevard, Sacramento, CA. The bidders are to allow the State five (5) working days to prepare and display the cores.

2) During the 2008 subsurface investigation, core samples were collected from several borings at 1.52 m (5 ft) intervals, when possible, and were submitted to the laboratory for strength testing. Some of the samples were so weak that they were unable to be tested. Per Standard Specifications, laboratory strength test data are available for viewing at California Department of Transportation, Transportation Laboratory, 5900 Folsom Boulevard, Sacramento, CA.

**CIDH Piles**

1) Ground water was encountered during the 2008 subsurface investigation and it is anticipated that the contractor will encounter ground water during CIDH pile construction. The static ground water levels indicated on the LOTB sheets reflect the measured ground water levels at the time of the piezometer readings. At the time of construction, the ground water surface elevations may be significantly higher or lower than those shown on the LOTB due to seasonal conditions, or the amount of water flowing in the region.

2) End bearing contributes to the nominal resistance of the CIDH piles at the bent locations. The contractor shall employ appropriate techniques to assure that the interface between the concrete and the rock at the base is free of drilling debris, so that the shaft concrete bears directly on the undisturbed rock. Caltrans field inspectors shall inspect the base immediately prior to the concrete placement. The Caltrans inspection camera shall be used for inspection and the procedure shall be cited in the specifications.

3) The formational rock described as Shale, Sandstone, Serpentine, and Greywacke is extremely variable in hardness, fracturing, and weathering, ranging from very hard to very soft, slightly to very intensely fractured, and slightly weathered to decomposed. Therefore, at all support locations, the contractor should anticipate variable drilling conditions in the formational rock similar to the exploratory drilling conditions. The contractor should also anticipate the need to alternate from soft and hard rock drilling techniques to extend the drilled holes for the CIDH piles to the specified pile tip elevations.

4) During the 2008 and 2009 subsurface investigation, significant variations in the weathering, fracturing, and hardness of the sedimentary formational bedrock material, occurring within relatively short distances both laterally and vertically, were observed, and are shown in the LOTB sheets. In the formational units, the contractor should anticipate varying rock drilling conditions (alternating soft and hard rock drilling) across all the bent locations. The variations in rock conditions (described above) can occur from one pile location to the next pile location. The contractor should also be prepared for potential caving conditions within the formational unit. The amount of difficulty the contractor will experience will be dependent upon the methods and means the contractor chooses to use to construct the CIDH piles.

5) The contractor will need to use care while drilling the shafts for the CIDH piles. Due to the nature of portions of the formational rock units, rapid insertion and removal of the drilling tools during the drilling process can cause excessive scouring and caving of the walls of the drilled shaft.

6) The skin friction zones needed to calculate the geotechnical capacity of the CIDH piles used as well as the specified minimum casing top and bottom elevations for each pile are summarized below in Table 8. Casings are specified for one or several of the following reasons. Prevention of ground loss in the lowest strength foundation soils, and providing construction access to the shaft cut-off elevation.

7) The pile casing elevations for Bents 2, 3, and 4 are shown in Table 8. In addition, the column isolation for bents 5 and 6 are shown in Table 9. The column isolation is to provide a gap between the column above the cut-off elevation and the foundation rock. The casing bottom elevations shown below are the highest elevations allowed. The contractor may choose construction equipment and construction techniques that require casing diameters, wall thicknesses, casing types, and casing tip elevations which are different than those shown in the plans and specifications. It is expected that the drilling contractor will use his expertise to provide a casing configuration that meets his needs.

8) The contractor may choose methods other than casing below the specified permanent casing elevations to stabilize the drilled holes.

**Table 6 - CIDH Pile Casing lengths and Skin Friction Zone Elevations (Alternative B)**

| Location | Ground elevation O.G (Ft) | Casing type and size I.D | Pile cutoff elevation (Ft) | Maximum Bottom of casing elevation (Ft) | Skin Friction Zone Start Elevation (Ft) | Skin Friction Zone End Elevation (Ft) |
|---|---|---|---|---|---|---|
| Bent 2 | 58 | 10-Ft Steel | 36 | -9 | -9 | -70 |
| Bent 3R | 40 | 10-Ft Steel | 37.6 | -121 | -121 | -164 |
| Bent 3L | 42 | 10-Ft Steel | 37.6 | -103 | -103 | -154 |
| Bent 4R | 47 | 10-Ft Steel | 45 | -30 | -30 | -92 |
| Bent 4L | 51 | 10-Ft Steel | 45 | -21 | -21 | -82 |

**Table 7 - CIDH Column Isolation and Skin Friction Zone Elevations (Alternative B)**

| Location | Ground elevation O.G (Ft) | Pile cutoff elevation (Ft) | Top of column isolation casing elevation (Ft) | Bottom of column isolation casing elevation (Ft) | Skin Friction Zone Start Elevation (Ft) | Skin Friction Zone End Elevation (Ft) |
|---|---|---|---|---|---|---|
| Bent 2 | 58 | 36 | 58 | 36 | -9 | -54 |
| Bent 5 | 76 | 70 | 76 | 70 | 70 | 27 |
| Bent 6 | 121 | 95 | 121 | 95 | 95 | 50 |

If there are any questions, please contact Hossain Salimi at (916) 227-7147.

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